Richard Byrom, William Fairbairn: the Experimental Engineer. A Study in Mid-19thcentury Engineering. Market Drayton: Railway and Canal Society

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Gordon Masterton

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quarter of the century. These mills ceased spinning in the 1930s and were partially demolished, with the remaining buildings being cleared in 1999. It is perhaps surprising that a dedicated study of Stockport's historic cotton industry has yet to be published, despite the pioneering role that the town played in the early development of the region's cotton industry. In this respect, Roger N. Holden very usefully places Palmer Mills and Stockport in their wider context of the Lancashire cotton industry in the introductory chapter. This is complemented by an account of the original mills, and an analytic description of the larger mills that replaced them. The narrative on the fabric and structural design of the later mills is accompanied by an exposition of the machinery employed in the various departments of the mill. The text is enhanced by numerous photographs and plans, all reproduced in monochrome.

It is commendable that these two comprehensive and privately funded studies of individual mill complexes have been brought to publication, making an important contribution to the growing corpus of material that looks at the fabric of Lancashire's historic textile industry. They provide valuable reference material for anyone researching the cotton industry, and informative to those with a wider interest in the cotton industry of Oldham and Stockport. It is to be hoped that further volumes on other mills may be forthcoming in the future.

The third volume, *Manufacturing the Cloth of the World*, is the first comprehensive study of the weaving sector of the Lancashire cotton industry to be published. It provides a succinct account of the development of weaving mills in the Lancashire manufacturing districts, focusing on technological and economic considerations rather than the social and political aspects of the weaving industry. In common with the author's earlier and acclaimed study of Stott & Sons, the pre-eminent Oldham mill architects, his study of weaving mills is concerned primarily with the methods of construction and organisation around the manufacturing processes. Evidence gained from archaeological study and meticulous documentary research is combined to create a definitive account of weaving mills in Lancashire. Following an engaging introduction to the development and progress of the industry, a useful explanation of the production processes provides the context for the evolution of weaving through the 19th and 20th centuries. The key research into the structural development of the characteristic north-light shed, their associated power systems and the resultant form and layout of weaving mills is the subject of the three longest chapters in the book. The text is supported throughout by a plethora of photographs, plans and diagrams to provide a clear explanation of a complicated subject, although all the images are monochrome. The final sections of this 268-page volume include a comprehensive bibliography of primary and secondary sources and a full index.

Manufacturing the Cloth of the World is quite simply an essential text for anyone researching Lancashire's textile industry, providing an invaluable companion to the earlier *Cotton Mills in Greater Manchester*. It will also be of considerable interest to economic and architectural historians, and those with a wider interest in the region's rural and urban industrial landscapes.

All three volumes are available through Lulu, a print-on-demand publishing service that provides authors with a welcome opportunity to publish their work in a cost-effective manner. It also enables specialised research such as the studies of Chadderton Mill and Palmer Mills to appear in print, which may not be taken forward by mainstream publishers.

IAN MILLER
University of Salford

RICHARD BYROM, *William Fairbairn: the Experimental Engineer. A Study in Mid-19th-century Engineering*. Market Drayton: Railway and Canal Society, 2017. 440 pp., 192 illus. £40 (hb). ISBN 978-0-901461-4-3

This superb account is the result of many years of deep study into the life and works of one of the greatest of the breed of engineer entrepreneurs that emerged in the mid-19th century. It is the first biography of Fairbairn for 140 years, and commendably thorough, but it also provides insights into the motivations and the networks behind the great industrialists, engineers and scientists of the era, better allowing us to understand the growth of practical knowledge and its influence on business.

Fairbairn's output was prodigious. He created and grew viable business lines in mill work, cast iron, wrought iron, bridges, cranes, locomotives and ships and the organisational structure to make them succeed (but not, ultimately, to endure). Fairbairn was not consumed by a single-minded obsession with profit. Despite the pressures of running businesses, he made time for the publication of original work, much of it empirically and experimentally based, and delivered papers to the premier learned societies of his day. In that sense, he was an enlightened industrialist, hungry for knowledge, and with the imagination to apply it to useful effect across a wide and varied output.

Byrom gives a good insight into the young Fairbairn's influencers who moulded his work ethic, not least through the writings and sermons of the Revd Hugh Blair, who later became a friend, and his early life experiences in Scotland and Newcastle. His

transition from journeyman millwright to emerging industrialist was helped by his appetite for reading and the ease in which Fairbairn was accepted into networks — whether Scottish manufacturers, Manchester Unitarians or the Manchester Mechanics Institute — and he worked those networks very well.

But networks do not create great businesses, they merely help successful ones flourish. The fundamentals of Fairbairn's approach were sound, and his mill shafting and waterwheels were world-leading. Byrom reveals many Fairbairn influences on European industrial and scientific advances. The episode on Fairbairn's interest in the human bone structure, including the curved femur of rickets sufferers, and how that may have inspired a whole line of enquiry through Culmann (who visited Fairbairn in 1849) and von Meyer to a seminal work on bone structure by Julius Wolff was particularly enticing.

Fairbairn's best-known civil engineering achievements are the supervision of the fabrication and erection of the great tubes for the railway bridges at Conwy and Britannia, designed by Stephenson — a working relationship which did not outlive the bridges' construction phases. Byrom deals very fairly with the significance of the tube form, much less of a blind alley than others have claimed. They led to Fairbairn's successful tubular-girder bridges and accelerated the emergence of wrought iron. But the singular aspect of both was the demonstration of the value of large-scale testing when dealing with structural forms that lay just beyond the confidence limits of available mathematics. We have Fairbairn, the experimental engineer, to thank for that.

Byrom does not shirk from highlighting the great man's weaknesses, neatly avoiding straying into hagiography, that bear trap for biographers. Fairbairn does emerge more sympathetically than most of his contemporaries, family members included, but not without good reason. He was the archetypal patriarch who had ambition and pride enough to wish for a family dynasty as his legacy, but failed to hand down the same drive and energy for business to the next generation. Whether this was through short-sightedness or, having handed over decision-making, the absence of powers to intervene, is debatable. Byrom makes a convincing case that Thomas, the son who inherited the businesses, was singularly unsuited and lost interest in their long-term continuity after floating the company in 1864. He chose then not to reinvest capital, but to buy himself a substantial landed estate. The analysis rings true.

The Ancoats works became a magnet for aspiring engineers, and while Fairbairn did not succeed in founding a long-lasting family dynasty, he can certainly claim credit for influencing a small army of successful engineers. No less than five professors of engineering served as pupils to Fairbairn, including James Thomson, Lord Kelvin's older brother, Fleeming Jenkin, the first Regius Professor of Engineering at the University of Edinburgh, and William Cawthorne Unwin. J.F. Bateman, the great water engineer, was his son-in-law and C.S. Allott, another star pupil, went on to found the biggest consulting engineering practice in Manchester (much later acquired by Babtie and in turn by Jacobs). It is Fairbairn's knowledge-line rather than his blood-line that became his enduring legacy to engineering. Ironically, his brother Peter, whose son Andrew had the sense to recruit business expertise and leadership from outside the family, was to leave an engineering company lasting well into the 20th century, though it had never reached the heights of William Fairbairn and Sons.

For those who love lists (who does not?), Byrom includes a thorough inventory of Fairbairn's mills, waterwheels, steam engines, ships, marine engines, locomotives and bridges to a level of detail defined by the rigour of his PhD study, giving us a valuable printed resource. Byrom's commendable rigour can overextend into the body of the text when we are treated at times to the exhaustive citation style of a PhD seeking to impress examiners — which disturbs the flow for any other reader.

The book is adorned with copious notes and references (hugely valuable for future researchers), but these are combined into a single list at the end of each chapter. Enthusiastic readers will want to read the supplementary notes, but not the citations, so this leads to constant cross-referral with a 20% chance of leading to something of interest, which is slightly irritating. The sharpness of a few of the images is disappointing, an oversight in the publisher's quality control (the first image in the book, Kelso Bridge, is one of the poorest, giving an unfortunate first impression), but great credit should be given to the Railway and Canal Society for having the boldness to publish a more ambitious volume than most in their stable.

However, these minor cavils are entirely forgivable for the depth of Byrom's research and insightful analysis, his inventories and his excellent index. Make no mistake, this book is a tour de force, a testament to the towering influence of Fairbairn and a very welcome addition to the canon of 19th-century engineering biographies.

GORDON MASTERTON
University of Edinburgh

JULIAN GLOVER, *Man of Iron, Thomas Telford and the Building of Britain*. London: Bloomsbury, 2017. 462 pp., 24 colour illus. £25.00. ISBN 978-I-4088-3746-7

The publisher's blurb makes bold claims for this book. It suggests that 'Drawing on contemporary accounts, this, the first full modern biography of Telford, at once intimate and expansive, is an utterly original portrait […] of how one man transformed